

Notice of Allowability

Application No.

10/711,145

Examiner

Brook Kebede

Applicant(s)

CHEN ET AL.

Art Unit

2823

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the RCE filed on January 16, 2007.
2. ☒ The allowed claim(s) is/are 1,4,5,9-11 and 13.
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
 5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit
of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☒ Interview Summary (PTO-413),
Paper No./Mail Date _____.
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

Brook Kebede
BROOK KEBEDE
PRIMARY EXAMINER

Art Unit: 2823

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on January 16, 2007 has been entered.

EXAMINER'S AMENDMENT

2. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Mr. Howard M. Cohn on March 27, 2007.

3. The application has been amended as follows:

In the Claims:

Change claim 1 to --Method of forming an interconnect structure comprising the steps of: depositing a dielectric layer of ultra low-k material; forming a hard mask over the **dielectric** layer, wherein the hard mask comprises: a layer of silicon carbide **(SiC) material including** (SiCOH) material overlying the dielectric layer; and a layer of oxide material overlying the silicon carbide material; etching trenches in the dielectric **layer**; depositing a liner over the hard

Art Unit: 2823

mask and within the trenches; and overfilling the trenches with a conductive material; performing a chemical mechanical polishing process to remove the conductive material which is atop the liner, thereby exposing the liner; removing the portion of the liner which is atop the hard mask using a Gas Cluster Ion Beam (GCIB), leaving the conductive material protruding from the trenches; and removing the layer of oxide material using a wet etch process, leaving the layer of silicon carbide material, the conductive material and the liner material above the layer of silicon carbide material protruding from the trenches; and performing a touch-up polishing process to remove the conductive material and the liner protruding from the trenches.--.

Change claim 9 to --The method of claim 1, further comprising the step of: ensuring that the layer of oxide material is thick enough such that topographical variations after the chemical mechanical polishing process and the removal of the liner are entirely within the layer of oxide material of the hard mask.--.

Change claim 13 --The method of claim 1, wherein the touch-up polishing process comprises using an abrasive-free or low-abrasive polish to obtain a very high selectivity between the conductive material and the silicon carbide material of the hard mask.--.

Allowable Subject Matter

4. Claims 1, 4, 5, 9-11 and 13 are allowed over prior art of record.

Reasons for Allowance

5. The following is an examiner's statement of reasons for allowance:

Art Unit: 2823

After further search and consideration of the amendment filed on November 14, 2006, it is determined that The prior art of record neither anticipates nor renders obvious the claimed subject matter of the instant application as a whole either taken alone or in combination, in particular, prior art of record does not teach “removing the portion of the liner which is atop the hard mask using a Gas Cluster Ion Beam (GCIB), leaving the conductive material protruding from the trenches; and removing the layer of oxide material using a wet etch process, leaving the layer of silicon carbide material, the conductive material and the liner material above the layer of silicon carbide material protruding from the trenches; and performing a touch-up polishing process to remove the conductive material and the liner protruding from the trenches,” as recited in claim 1.

Claims 4, 5, 9-11 and 13 are also allowed as being dependent of the allowed independent base claim.

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure Dalton et al. (US 2002/0074659), Chen et al. (US 2002/0182853) and Choi et al. (US 6,486,082) also disclose similar inventive subject matter. However, the prior art neither teaches nor renders obvious the aforementioned claimed limitations of the instant application either taken alone or in combination.

7. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled “Comments on Statement of Reasons for Allowance.”


Art Unit: 2823

Correspondence

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brook Kebede whose telephone number is (571) 272-1862. The examiner can normally be reached on 8-5 Monday to Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew S. Smith can be reached on (571) 272-1907. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.


Brook Kebede
Primary Examiner
Art Unit 2823

BK
March 29, 2007